An Interactive Tool for Teaching Right Management in 3D E-learning Platform

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Abstract

With the development of 3D virtual reality in the field of E-learning, the access to distributed and heterogeneous data sources, such as 3D spatial information, pictures, audios/videos and other contents has become a hot research topic. Considering E-learning users' experience, as well as data security, we propose an improved spatial role-based access control (SRBAC) as the underlying model. Finally, we design a teaching right management system and make some verified tests in the 3D system, OpenSim.

CR Categories: D.4.6 [Security and Protection]: Access Control; I.3.7 [Three-Dimensional Graphics and Realism]: Virtual Reality;

Keywords: access control, space, SRBAC, OpenSim

1. Introduction and Motivation

As various 3D virtual reality systems have emerged, people increasingly apply this technique in various fields, such as the eBusiness, eLearning, computer game and social platforms [Craig et al. 2009]. As a large number of users can easily acquire legal identities to log in, such systems are vulnerable to be attacked in the network [Fernandez-Baca, 1989]. Additionally, when it comes to heterogeneous data sources distributed in the environment, it seems to be more important for the design of access control mechanism. According to the results of related research, spatial structure may offer people private awareness in real world [GD Abowd et al., 2002]. Therefore, boundaries in virtual world could be helpful for social network building [Fallman, 2011]. In a word, a good access control method need to balance the security and user experience.

In this paper, we give an analysis of access control techniques from 3D virtual reality systems. Based on a good knowledge of the architecture of 3D distributed system, OpenSim, we define a set of interfaces to integrate the teaching rights management system and then, validate its feasibility. In the future, we will further make a survey to compare our system with existing 3D systems in terms of the sense of immersion and user experience.

2. Research Background

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Existing virtual reality platforms like Open Wonderland, Second Life and Active World are used for various purposes, but still adopt traditional access control methods. For example, in Active World, people can authorize each other just by passing "Permissions Password". In Open Wonderland, there is an access control list for each virtual object, which describes all the operations could be executed on it. As can be seen in Figure.1, through the RESTful web service, Second Life can grant legal users the unique ID by which they can request for accessing data sources.

Obviously, these models can basically ensure data security, but fail to make good use of the information from a typical 3D world, like spatial structure and object identifiers. With regard to this, we find the spatial role based access control, mainly applied in current wireless service, could be improved and applied in the 3D virtual environment. With the consideration of data security and user experience, here we make changes in existing SRBAC, design and implement a teaching right management system based on it. In the next work, we will set up a pilot program among primary and secondary schools, in order to prove our initial ideas and, further, enrich our existing research project.

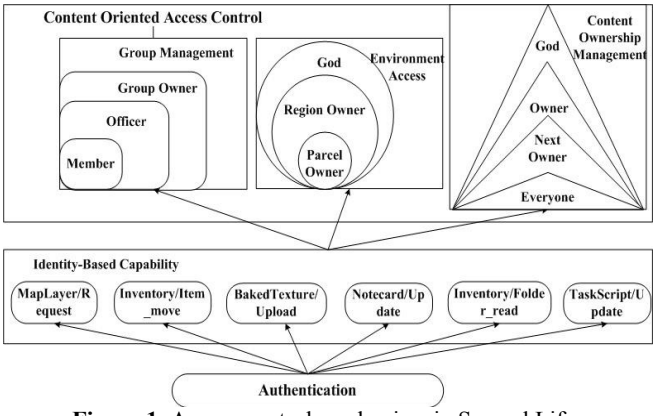

Figure 1. Access control mechanism in Second Life

3. Our Approach and Tests

So far, spatial role-based access control is mainly applied in the local-based services in wireless environment. By adding spatial information in the RBAC model, permissions could be authorized to the users with a particular role in the given region. For example, F. Hansen et al applied this method in a medical information system, by which medical workers can provide some healthcare services to patients in specialized regions. In this system, users' permissions could be updated by localizing their mobile terminals [F. Hansen et al, 2013].

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Based on the literature reviews and analysis on 3D platforms, we plan to adjust the existing SRBAC model in terms of **Space Identifiers and Location.**

Space Identifiers. As it is directly controlled by computer system, each 3D space unit is corresponded to an identifier, like < 001, Space1>. To facilitate the space management, most 3D platforms own a set of hierarchical space. Through the hierarchical management, people are not only able to define spaces, but also divide them into smaller ones dynamically. As is shown in Figure.2, In the Space, Space1 and Space2 can be defined. Then, according to requirements, Space1 could be further divided into Space1.1 and Space1.2. In this way, the scalability could be maintained.

Space identifiers may be recognized by the running programs, but is difficult for common users to understand and memorize. Therefore, we here also define a set of practical spaces based on the specific application. For example, we define practical places for a teaching scene, including the "Campus"(Space), "Classroom"(Space1 and Space 2) and "Group Venue"(Space1.1 and Space 1.2).

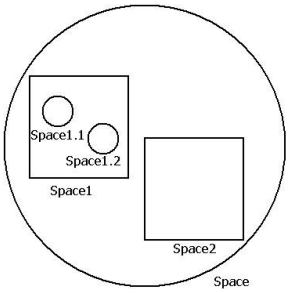

Figure 2. Hierarchical spatial structure in 3D platforms

Obviously, practical spaces are helpful to understand the function and service, while spatial identifiers could be recognized by system. By monitoring users' location, checking the SpaceID, the practical space could be returned, and users' permissions could be updated. This characteristic will, undoubtedly, facilitate the application of SRBAC into 3D platforms.

Location. Compared with traditional application of SRBAC as the wireless service, we can refine right management by locating virtual objects in 3D world. For example, a user may be authorized the "read" to "book", like p1 = (book, read). By using the SRBAC, all the objects could be identified and localized, and the permission can be further depicted as p1 = (book, read room1), which means the "book" could be read only in room1.

Due to the high cost of positioning technologies such as GPS, Wi-Fi and RFID, only the objects with a great importance may be identified in real world. Besides, the position in SRBAC should be accurate, while it is hard to guarantee in real world. However, this problem could be solved easily in virtual environment: firstly the 3D spatial structure serves as the premise of SRBAC application; secondly, as directly processed by computer system, the accuracy can be guaranteed, and all the virtual objects can be identified and positioned. This, no doubt, can refine the access control rules.

Our approach is quite suitable for a component-based architecture: linking the management system as a single module to the main system, in order to control the access right, without affecting any other functions in the OpenSim. In our implementation and tests, we use XML files to store the access control data. At the meanwhile, we also define a set of interfaces to bridge the main system and several services. In the Figure.3, as the access control server starts, all the clients in network can communicate and exchange the access control data with it.

In the stage of experiment, we take the "classroom questioning" as an example. Firstly we define classrooms, Classroom-1 and Class-room–2 and Class-room–3, corresponding to Space1, Space2 and Space3 in the system. Each of them is distributed a group of students and teachers respectively. Once the students or teachers are detected not in their belonging classrooms, they will not be granted operations to any objects in the current spaces.

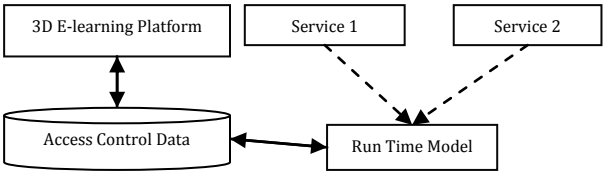

Figure 3. Bridge services to the main system

4. Conclusions and Future work

With the consideration of data security and the experience of target users, we make adjustments based on traditional spatial role-based access control. In this paper, we use the XML techniques and component loading to implement a teaching right management system, ensuring the data security and user experience in the 3D E-learning platform.

To further verify the practicability and the improvement of the sense of immersion, we plan to set up a pilot project in primary and secondary schools. According to the feedbacks from teachers and students, we will make adjustment and improve our existing project.

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References

CRAIG, A., SHERMAN, AND W.R., WILL, J.D. 2009. Developing Virtual Reality Applications: Foundations of Effective Design. Morgan Kaufmann, San Mateo. pp: 110-112.

FERNANDEZ-BACA, D.: Allocating modules to processors in a distributed system, 1989. IEEE Transactions on Software Engineering, vol. 15. pp: 1427-1436.

ABOWD G, MYNATT E AND RODDEN T.:The human experience [of ubiquitous computing], 2002. *IEEE Pervasive Computing,* pp:48-57.

FALLMAN, D. The new good: exploring the potential of philosophy of technology to contribute to human-computer interaction, 2011. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11)*, ACM, New York, USA, pp: 1051-1060.

HSU CH-L, LEE M-R.. User Acceptance of A Community-based Healthcare Information System Preserving User Privacy, 2013. *7th UAHCI International Conference: HCI International*, Las Vegas, USA, pp: 453-462.